Universal Command Converter
User's Manual

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Chapter 1
Application Development System

The Motorola Universal Command Converter is one component of a four-component development tool for designing real-time signal processing systems. When combined with a host card, a target board, and Motorola software and documentation, the universal command converter becomes part of an advanced development tool called an application development system (ADS). The ADS consolidates complex hardware and software development tools within a low-cost workstation environment using a well-supported operating system. By providing a solid foundation for application development and testing, the ADS significantly reduces development costs and time to market. The versatile ADS allows rapid initial development and supports comprehensive testing of prototype designs. The ADS consists of the following four components:

- **Host-Bus Interface Board**—a 16-bit ISA bus (for PC-workstations and HP700 workstations) and SBus (for Sun and SPARC workstations).

- **Command Converter (CC)**— a universal design that supports all Motorola DSPs.

- **Control, Development, and Debugging Software**—available in Windows® compatible (Windows 95/NT 4.0), Sun OS compatible (Rel. 4.1.1 or later), Solaris compatible (Rel. 2.5 or later), and HPUX compatible (Ver. 9.0 or 10.20).

- **Application Development Module (ADM)**— supports development and testing using a specific digital signal processor (DSP) chip. To identify currently available ADMs, consult your local Motorola distributor, a Motorola semiconductor sales office, or, for the latest information, Motorola's DSP tools home page on the Internet (http://www.mot.com/SPS/WIRELESS/dsptools).

For more information about ADS software, you can obtain a copy of the *ADS User's Manual* from the Development Tools CD included with the kit or from the following web address:

http//:www.mot.com/SPS/DSP/documentation/tools.html

Motorola DSPs have a common On-Chip Emulation (OnCE™) module that gives different development tools identical features. Using the concept of a common serial debug port, one set of tools has been designed to allow a user to communicate with any of the architectures using a single command converter. In some Motorola DSPs, this module

uses a dedicated OnCE serial port to access the internal module. In other Motorola DSPs, the internal OnCE module is addressed using the IEEE Joint Test Action Group (JTAG) four-wire test access port (TAP) boundary scan architecture protocol. The tools software can use either the direct OnCE serial port or the JTAG serial port.

This manual describes the installation, use, and functional description of the control system that interacts with the target DSP.

1.1 General Description

The ADS is a tool for designing, debugging, and evaluating DSP-based systems. It consists of three hardware circuit boards, as illustrated in Figure 1-1, and two software programs. The hardware circuit boards are the host-bus interface, the command converter, and the ADM. The two software programs are the ADS user interface program, which is executed on the host computer, and the command converter monitor program which is expected on the command converter. Figure 1-1 illustrates the ADS being used as a hardware evaluation tool or host software accelerator. The ADM card has a 14-pin connector, which provides an access point for the command converter JTAG/OnCE interface.
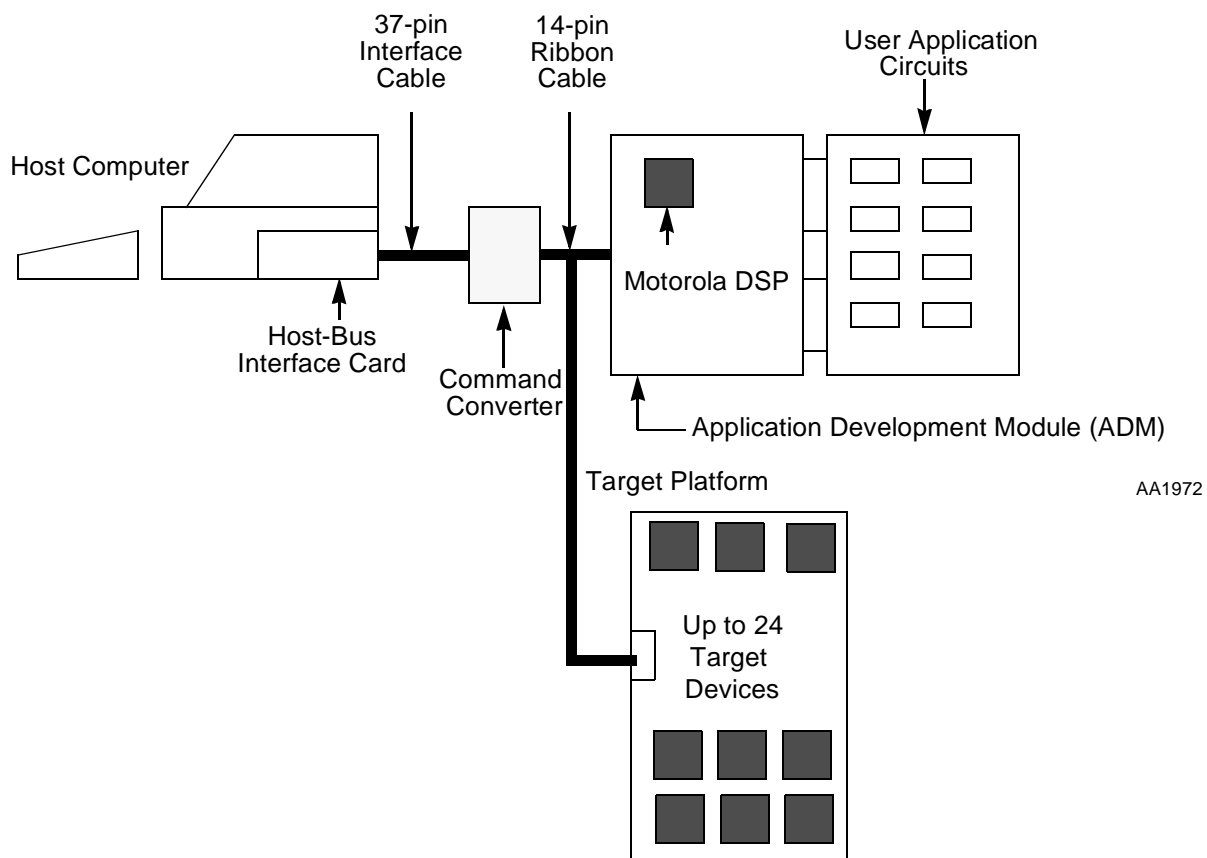
Figure 1-1.   Application Development System or Target Platform Emulation

Figure 1-1 also illustrates how the ADS can be used as an emulator for a defined target system whose hardware or software the user needs to debug. Here the user must provide an access point on the target hardware for a 14-pin JTAG/OnCE interface cable, which may be as simple as a 2-row × 7-set of test points. Chapter 3, "Functional Description," provides complete details of the pinout on the JTAG/OnCE interface cable.

The ADS software program provides routines the user needs to communicate with the target DSP on the ADM or the target application. This program has a group of powerful commands that enable the user to perform a variety of tasks. Operating system command calls may be made from within the program, or temporary exits to the operating system may be made without disturbing current set-ups with the target DSP.

For more information about the above paragraph, refer to the *ADS User's Manual* which can be found on the Development Tools CD included with the kit or at the following web address:

http//:www.mot.com/SPS/DSP/documentation/tools.html

The Host interface board provides a physical link between the HOST computer and the Command Converter via a parallel data and control bus cable. The parallel data path is used for high-speed data transfers. The control bus signals enable the HOST computer to reset, interrupt, and send commands to Command Converter simultaneously or sequentially. The command converter then sends the reset, intercept, and various commands to the ADM via the JTAG/OnCE cable.

The ADM is the basic platform for evaluating the DSP. It contains a DSP chip with a JTAG/OnCE interface connector to configure it as a slave to the HOST computer or as a stand-alone unit. In the slave configuration, the user controls the DSP processor and is able to interrogate its status. This enables the user to debug hardware and software easily. In the stand-alone configuration, a user program resident in ROM controls the ADM and may be used as a prototype system for an end product.

1.2 Operating Environment

The ADS hardware and software is currently supported on the following three host computers:

- PC-workstations
- Hewlett Packard HP700 workstations
- Sun-4 and compatible workstations

1.2.1 PC-Workstation Requirements

The minimum hardware requirements for the PC-workstation ADS user interface program include the following:

- PC-compatible (Pentium® class) with
- Windows 95 with 16MB of RAM/NT 4.0 with 32MB of RAM
- CD-ROM drive
- Hard drive with 15MB of free space
- Mouse and keyboard
- One 16-bit I/O ISA expansion slot
- Free I/O addresses 100-102 hex, or 200-202 hex, or 300-302 hex.

1.2.2 Hewlett Packard HP700 Workstation Requirements

The minimum hardware requirements for the HP-workstation ADS user interface program include the following:

- HP700 Workstation running HPUX Version 9.0 or 10.20
- 32MB of RAM
- CD-ROM drive
- Hard drive with 20MB of free space
- Mouse and keyboard
- One EISA expansion slot

1.2.3 Sun-4 or Compatible Workstation Requirements

The minimum hardware requirements for the Sun-workstation ADS user interface program include the following:

- SUN Operating System Release 4.1.1 or later or SOLARIS Release 2.5 or later
- 32MB of RAM
- CD-ROM drive
- Hard drive with 20MB of free space
- Mouse and keyboard
- One SBus expansion slot

1.3   ADS Software Features

Please refer to the *ADS User's Manual* for detailed information on the software features. The *ADS User's Manual* can be found on the Development Tools CD included with the kit or at the following web address:

http//:www.mot.com/SPS/DSP/documentation/tools.html

Chapter 2
Preparation and Installation

The ADS provides a tool for designing, debugging, and evaluating DSP based systems. It consists of three hardware circuit boards, as illustrated in Figure 2-1. The hardware circuit boards are the Host-Bus interface, command converter, and the ADM. The Host-Bus interface card resides on the host systems bus and communicates with the command converter via a 37-pin ribbon cable. The command converter interfaces with the ADM card via a 14-pin connector which provides an access point for the command converter's JTAG/OnCE interface.
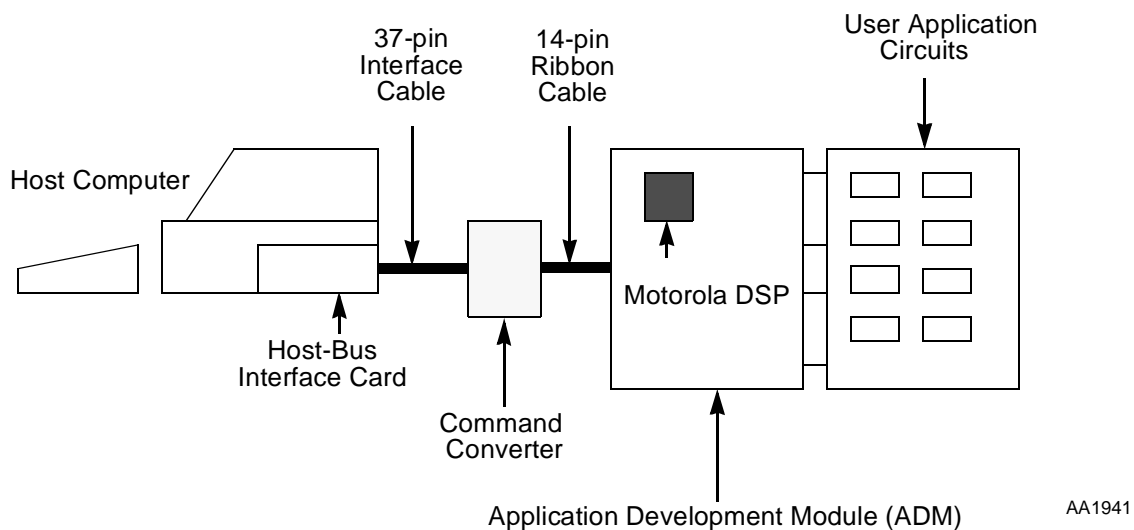
Figure 2-1.   Application Development System

2.1   Host Computer Interface Card

This section covers the Host Computer Interface card hardware and software installation instructions for the different host computer platforms, i.e. PC-workstation, SUN 4 workstation and HP700 workstation.

2.1.1   PC-Workstation to Command Converter Interface

The interface between the command converter and the ADS user interface program is handled by a circuit board that resides in one of the PC-workstation motherboard system

ISA expansion slots. A single PC-workstation interface card can control up to eight command converters.

2.1.1.1 Installing the PC-Workstation's Interface

> **Warning**
>
> Before removing or installing any equipment in the PC-workstation computer, turn off the power and disconnect the power cord.

Refer to the appropriate installation and set-up manual for your PC-workstation for instructions on removing the system cover.

Jumper group JG1 selects the interrupt asserted on the host processor by the host interface card when the target DSP device makes a service request (for example, by reaching a breakpoint).

Note: The ADS software does not support interrupts. No jumper should be placed on JG1 when used with the ADS software.

Jumper group JG2 specifies the host interface card I/O address. The host interface card supports 16-bit I/O addresses and uses three consecutive addresses from the specified address. The starting address may be configured, with jumper pairs A8–A15 in JG2, to any multiple of $100, up to $FF00. Place a jumper over a pair of pins to set that address bit to 0; remove the jumper to set the address bit to 1. Address bits A0–A7 are not decoded. In Figure 2-2, the selected address range is $100–$102.

Note: Although the host interface card supports 16-bit addressing, the ADS software only supports addresses $100, $200, and $300.

Once you have ensured that the selected address does not conflict with another expansion card installed in the motherboard, you may install the host interface card. Figure 2-2 illustrates the physical locations of JG1 and JG2.
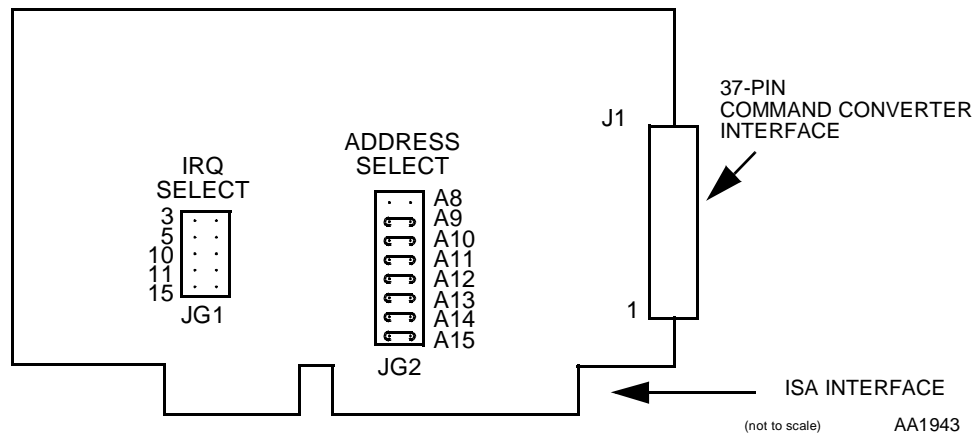
Figure 2-2. PC-Workstation Interface Card Jumper Group Locations

The host interface card resides in the PC-workstations I/O bus; the ADS user interface software communicates with the card through this I/O address block. The host interface card address block may be changed to start at one of three addresses as described in Table 2-1.

Table 2-1. PC-Workstation I/O Addresses

PC-Workstation I/O Address	PC-Workstation Peripheral	JG1
100–102 (default)	Undefined	A8 open, all other pairs linked
200–202	Game Port	A9 open, all other pairs linked
300–302	Prototype Port	A8, A9 open, all other pairs linked

If the host interface card address block is changed from the default $100, the selected address must be specified to the ADS. This may be done in one of the following three ways:

- Set the environment variable ADMADDR: >SET ADMADDR=200
- Issue the ADS command HOST: > host io 200
- Use the -d option on the ADS command line: >ADS56300 -d 200

To install the host interface card properly, position its front bottom corner in the plastic card guide channel at the front of the PC-workstation chassis. Keeping the top of the host interface card level and any ribbon cables out of the way, lower the card until the card connectors are aligned with the PC-workstation system board expansion slot connectors. Using an evenly distributed pressure, press the host interface card straight down until it seats in the expansion slot.

Secure the host interface card to the PC-workstation chassis using the bracket retaining screw. Refer to the PC-workstation installation and set-up manual for instructions on reinstalling the cover.

The host interface card is factory-configured for no interrupts and address decoding at $100–$102 of the PC-workstation I/O address map, which are undefined peripheral addresses.

Note: Jumper JG2 should be left disconnected.

2.1.2   Installing the PC-Workstation Software

A GUI debugger program that supports multiple windows, menus, and dialog boxes is available for use in the Microsoft Windows environment.

2.1.2.1   Defining Environment Variables

The following sections specify environment variables which may need to be defined to establish the correct operating environment for the ADS user interface software. These environment variables may be defined during system start-up by adding lines to the file c:\autoexec.bat, which applies to all versions of DOS and WINDOWS operating systems. Some Windows 95 installations may not use the autoexec.bat file. If it does not exist, it may be created and the SET commands inserted.

The general form of the SET command is as follows:

```
SET  symbolname=value
```

Use the names and values from the sections below, and do not use spaces around the "=" sign.

If the I/O address of the host interface card is changed from the default setting of $100, the ADS user interface program must be informed of the address to access the card. This may be done with the environment variable ADMADDR:

```
set admaddr=200
```

2.1.2.2   GUI Program Installation

To install the development software, place the Motorola DSP Software Development Tools CD in the CD drive. If the Motorola DSP Software Development Tools Setup does not appear within fifteen (15) seconds of activating the CD drive, you will have to manually install the software. To do so, position the mouse pointer over the Start icon on the Windows 95/NT toolbar and click once to bring up the selections. Move the mouse pointer to Run and click once. Move the mouse pointer to Browse and click once. In the dialog window that appears, select the CD drive on the computer. The file SETUP.EXE

should appear in the dialog window. If it does not, in the lower portion of the dialog window, select "All Files (*.*)" under "Files of type". Move the mouse pointer over SETUP.EXE and double click. When the Motorola DSP Software Development Tools Setup appears, follow the instructions.

2.1.3 SUN 4 to Command Converter Interface

The Motorola SBus/ADS Interface board is designed to be installed in an SBus slot on a Sun SPARC station or compatible workstation. The board provides a parallel communication path between the workstation and a Motorola DSP development system.

2.1.3.1 Installing the Sun-4 Interface

The Motorola SBus/ADS Interface is delivered ready to install in your SBus system. There are no user-configurable jumpers or hardware configurable options. Please consult the "SPARC station xxx Installation Guide" or the board installation instructions supplied with your SBus system for installation details. Following is a summary of the instructions in the Sun manual:

1. Save all open files, then shut down your system with the following series of commands:

```
hostname% /bin/su
Password: mypasswd
hostname# /usr/etc/halt
```

Wait for the following messages:

```
Syncing file systems... done
Halted
Program Terminated
Type b(boot), c(continue), n(new command mode)
```

2. When these messages appear, you can safely turn off the power to the system unit. Turn off power to the system, but keep the power cord plugged in. Open the system unit. Be sure to attach a grounding strap to your wrist and to the metal casing of the power supply. Follow the instructions supplied with your system to gain access to the SBus slots.

3. Remove the SBus slot filler panel for the desired slot from the inner surface of the back panel of the system unit. Note that the Motorola SBus/ADS Interface board is a slave-only board and thus will function in any available SBus slot.

4. Slide the SBus board at an angle into the back panel of the system unit. Make sure that the mounting plate on the SBus board hooks into the holes on the back panel of the system unit.

5. Push the SBus board against the back panel, align the connector with its mate, and gently press the corners of the board to seat the connector firmly.

6. Close the system unit.

7. Connect the 37-pin ADM interface cable to the SBus/ADS Interface board and secure.

8. Turn power on to the system unit and check for proper operation.

2.1.3.2   Software Installation

The distribution CD included with the ADS package contains the "mdsp" SBus device driver for the ADS as well as the ADSxxx user interface program for the ADS. The following steps will allow you to install the device driver and run the user interface.

Note: In the instructions that follow, ADSxxx represents the name of your particular system, such as ADS56000, etc.

1. Copy all of the software from the distribution CD onto your system using uncompress and tar. See the "readme" file for details

2. Install the driver with the following commands:

```
hostname# cd adsxxx/driver
hostname# make install
```

3. After a successful installation, you should see a module status message indicating that your module was successfully loaded and giving its ID. To see this status at any time, issue the "modinfo" command on SOLARIS, "modstat" for SunOS.

4. If the ADSxxx driver module was loaded properly, you should be ready to run the ADSxxx user interface:

```
hostname# cd ../bin
hostname# adsxxx
```

If for any reason you wish to uninstall the driver, use the following commands:

```
hostname# cd adsxxx/driver
hostname# make unload (SunOS 4.x)
hostname# make uninstall    (SOLARIS 2.x)
```

2.1.4   HP7xx to Command Converter Interface

The Motorola HP7xx Interface uses the same ISA card installed in the PC-workstation. It is controlled by an HPUX device driver. The HP7xx computer must have an ISA slot available for plugging in this card. Older versions of the HP700 series computer did not have ISA expansion slots. The ISA board provides a parallel communication path between the HP workstation and a Motorola DSP development system. For details on jumper

configurations of the ISA card, refer to Section 2.1.1, "PC-Workstation to Command Converter Interface."

The HP7xx device driver and user interface program support multiple host interface cards in a system. Therefore, when reading the software installation instructions keep in mind that the device driver name(s) must be different for each card installed in a system.

2.1.4.1 Installing the HP-7xx Interface

Before installing one or more ISA cards, a sequence of steps must be followed to shut down your system. If you are using HP VUE, carry out the first four steps of Section 2.1.4.1.1, "HP VUE Shut-Down." If you are using the HP-UX command line shell, carry out the first four steps of Section 2.1.4.1.2, "HP-UX Command Line Shell Shut-Down."

To shut down your computer you must first be logged in as "root". Save all open files before shutting down, and always follow the proper shutdown procedure before turning off the power to your workstation. Failure to do so could cause damage to files.

Note: "hostname#" represents the system prompt; that is, it is not to be entered as part of the command.

2.1.4.1.1 HP VUE Shut-Down
1. Use the HaltSystem application, located in the System_Admin file of the General toolbox, by double-clicking on its icon.
2. Click on the "OK, Halt System" button to initiate shut-down.
3. When the message "Halted, you may now cycle power" appears, you may safely turn off the power to your workstation.
4. Go to step 1 of Section 2.1.4.1.3, "ISA Card Installation."

2.1.4.1.2 HP-UX Command Line Shell Shut-Down
1. Change to the root directory with the following command:

   ```
   hostname# cd /
   ```
2. Enter this command to initiate shut-down:

   ```
   hostname# /etc/shutdown -h 0
   ```
3. When the message "Halted, you may now cycle power" appears, you may safely turn off the power to your workstation.
4. Go to step 1 of Section 2.1.4.1.3.

2.1.4.1.3 ISA Card Installation

The following steps should be used to install the ISA card:

1. Remove the power cord from both the wall socket and the unit.

2. Remove the power supply cover plate located on the rear of the unit and marked "TO ACCESS EISA PULL THIS HANDLE", and gently slide the EISA Adapter Card Assembly (hereafter called "assembly") out of the unit. See Figure 2-3.

3. Remove the blank EISA slot cover from the assembly. The cover is simply a piece of metal that covers the hole when there is no card installed and is held in place by a single screw. Be sure to save this screw as it will be used to secure the card.

4. Carefully slide the ISA card into the assembly, making sure that the connector pins on the assembly meet up properly with those on the card, and that the cable socket is positioned fully within the hole. Use the screw saved from the previous step to securely attach the card to the assembly.

5. Carefully slide the assembly back into the unit. Press firmly on all four corners to ensure that the connectors on the front of the assembly fully engage with those inside the unit.

6. Reinstall the power supply cover plate, and then reconnect the power cord to both the unit and the wall socket. Also connect the 37-pin ribbon cable from the ISA card to the ADM board.

7. The system may now be restarted.

POWER SUPPLY COVER PLATE

AC POWER CONNECTION   EISA CONNECTOR HOLE
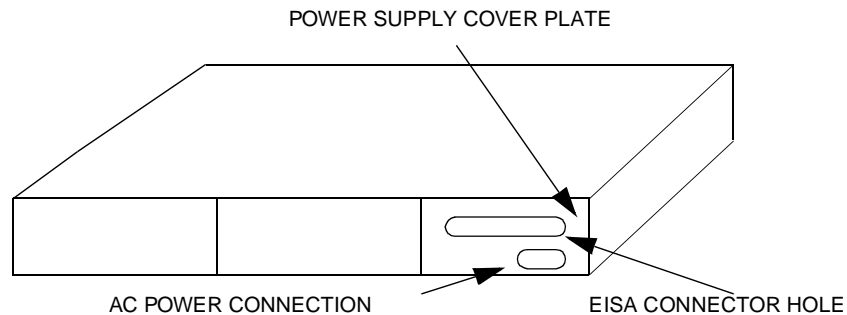
AA1944

Figure 2-3.   HP-7xx Chassis Rear View

2.1.4.2   Installing the HP-7xx Device Driver

An HP-700 formatted CD-ROM contains the necessary files for the installation of the device driver. The device driver supports multiple cards so only one device driver needs to be installed regardless of the number of cards being used. This CD is UNIX tar formatted and should be read in with the following command:

```
tar xvf /dev/rmt/0mn
```

An alternate command would be

```
tar xvf /dev/rmt/0m
```

The number at the end of the command is the device number and should be changed if the CD drive number is different on the machine being used. After the files are extracted from the CD-ROM, a directory named "driver" is created.

The user must be logged in as "root" or superuser to proceed from this point. The following steps should be followed for proper installation of the driver program:

Note: "hostname#" represents the system prompt; that is, it is not to be entered as part of the command.

The HP device driver for the ADS supports multiple host interface cards (up to three, limited by the addresses that can be selected on the host interface card) installed into a single HP-700 workstation.

1. When the files were installed, a directory called driver was created in the hierarchy. Make this the current directory now by executing the following command, where ADS-PATH is the path to where the ADS files were installed:

   ```
   hostname# cd  /ADS-PATH/driver
   ```

2. Copy and change the ownership, group and mode of the device driver library file, libmdsp.a, using the following commands:

   ```
   hostname# cp libmdsp.a /etc/conf
   hostname# chown bin /etc/conf/libmdsp.a
   hostname# chgrp bin /etc/conf/libmdsp.a
   hostname# chmod 444 /etc/conf/libmdsp.a
   ```

3. To install the device configuration file, type the following command. (Note that it may be necessary to escape the ! by using a backslash \, depending on the shell you are using.)

   ```
   hostname# cp  !MOT0010.CFG  /etc/eisa
   ```

   This copies the configuration file into the system EISA configuration directory. Modify the copy of the file in /etc/eisa to reflect the I/O port that the card is configured for (change the PORT entry).

   If you are using multiple host interface cards in your HP, make multiple copies of this file in /etc/eisa, changing the last digit of the file name on each copy. Modify each copy to have the correct ID and PORT entries (the ID entry should be the name of the file without the .CFG extension). Each PORT entry should be modified to contain the proper addresses for the additional cards that are supported.

4. Run the EISA configuration program by typing this command:

   ```
   hostname# /etc/eisa_config
   ```

At the EISA prompt, type "add !MOT0010.CFG <slot num>", where <slot num> is the slot number in which the card is installed.

If you have installed multiple host interface cards, repeat the "add" command once for each configuration file and slot. For example, if you created a file MOT0011.CFG for a card in slot 2, and modified the PORT and ID entries in MOT0011.CFG to reflect the I/O address of the card in slot 2, you would type add !MOT0011.CFG 2" to add that card to the EISA configuration information.

On machines with one EISA expansion slot, the slot number is 1.

Press "q" to quit the EISA configuration program, and "s" to save.

5. You must now edit the /etc/master file to include the ADS device driver. Make a backup copy of "/etc/master". You will need to change one line and add three new lines in this file. The entries will be in the "Third Party and User Drivers," the alias table, the driver/library table, and the library table.

Change the first available line of the "Third Party and User Drivers" section to look like the following line. An available line is one which has dashes in the first four entries. Note that the last two entries are already set and are not to be changed. The last entry is the major number for the device. You may use a line with 38, 39, 40, 42, or 43 for the major number. Make note of the number you choose, as it is used in the next step.

```
Name  Handle Type Mask Block Char (Do not add this line.)
mdsp  mdsp  1    1FA   -1   <major>
```

Find the alias table and add the following line:

```
mdsp  mdsp
```

Find the driver/library table and add the following line:

```
mdsp  libmdsp.a
```

Find the library table and add the following line:

```
libmdsp.a0
```

6. Make a device file for the driver by executing the following command:

```
hostname# mknod  /dev/mdsp0 c  <major> <minor>
```

The major and minor numbers of the device are given by <major> and <minor>, respectively. N is a user chosen device group number. The ADS user interface software always defaults to device group 0 or mdsp0.

Note: The <major> must be the same major number you used in the previous step. The minor number is 0x4S0000, where 'S' should be replaced by the card slot number in which the card was placed (1 – n). For machines with a single slot,

the slot number is 1. For example, slot 4 of a multi-slot machine would be 0x440000

Be sure to change the permissions for this file(s) by typing this command:

```
hostname# chmod  666  /dev/mdsp0
```

If you have installed multiple host interface cards, repeat the "mknod" and "chmod"steps for each new card. The <major> number for each will be the same, but the <minor> number will reflect the slot in which the card was installed. The device file names are arbitrary, but you should make note of which card corresponds to each device file name. We suggest using a final digit of "N– 1"for slot "N".

7. Edit the file /usr/sam/lib/kc/drivers.tx and add an entry for the ADS device driver. You may wish to make a backup of the file before editing it. Add the following line:

```
mdsp:::Out:Motorola ADS Host Interface Card
```

8. Select and edit a dfile (configuration description file). First, change directories by executing the following command:

```
hostname# cd  /etc/conf
```

A dfile must now be selected. Your current system dfile should be called either dfile, dfile.SAM (for a kernel that has been configured with the HP System Administration Manager), or a unique name given by you if you have altered your kernel configuration by hand. Use the dfile appropriate for your system. If you aren't sure which version to use, or if your choice doesn't work, then you can use the file created by the command

```
hostname# /system/TOOL/get_kdfile  /hp-ux > dfile.current
```

to get your current system dfile.

Make a back-up copy of the selected dfile and edit the selected dfile by adding the following lines to the top of it:

```
* Motorola DSP ADS Device Driver
mdsp
```

9. Generate the files needed to rebuild the kernel with your new device driver. Execute this command, replacing dfile-name with the dfile you selected in the previous step:

```
hostname# /etc/config dfile-name
```

10. Generate a new kernel object file in the current directory using the following command:

```
hostname# make  -f  config.mk  XOBJS=libmdsp.a
```

11. If the build finished successfully, your new kernel may now be installed. Make a backup of the current kernel by executing the following copy command:

```
hostname# cp  /hp-ux  /hp-ux.pre-ads
```

12. The final step is to install the new kernel in the root path and reboot the system. Note the period before the first slash in the first argument of the cp command:

```
hostname# cp  ./hp-ux  /hp-ux
```

To reboot the system using the new kernel, type the following command:

```
hostname# exec  reboot
```

During boot-up, you should see the following message displayed on the screen if the installation was successful:

```
"Slot  <slot-num>: Motorola DSP ADS Host Interface Card Initialized"
```

where <slot-num> is the previously selected slot number in which the card is installed.

The ADS Device Driver is now installed and ready for use. By default, the ADS program attempts to open the device file dev/mdsp0. If you want to use a different device (i.e., different host interface card), you can specify the device file name in an environment variable, or on the command line. The environment variable is ADMADDR. The command line option is `-d', followed by the name of the device file. The `-d' option must come before a command file name.

For example, to use /dev/mdsp2, you could set an environment variable before invoking the ADS software using the following statements:

```
# setenv ADMADDR /dev/mdsp2
# adsXXXXX [command-file] (where XXXXX is the device)
```

or you can invoke the ADS software with a command line argument such as the following:

```
# adsXXXXX –d /dev/mdsp2 [command-file]
```

2.2 Configuring the Command Converter

The universal command converter supports both the JTAG and OnCE serial protocols. The universal command converter may be identified by the surface-mount DSP56002 which controls its operation. The monitor program resides in SRAM, and is downloaded by the ADS software during command converter initialization and reset operations.

The universal command converter has two user-configurable jumper groups: JG2, which selects the device number, and JG1, which selects the power source for the JTAG/OnCE buffers.

2.2.1 Selecting the Command Converter Device Number

The command converter's JG2 jumper group selects the device number that this particular command converter will respond to when commanded by the user interface program. Table 2-2 describes the device address select option:

Table 2-2. Command Converter Device Number Selection

Device Address	JG2
0 (default)	no jumpers
1	5–6
2	3–4
3	3–4, 5–6
4	1–2
5	1–2, 5–6
6	1–2, 3–4
7	1–2, 3–4, 5–6

Note: All command converters are factory configured for device address 0.

2.2.2 JTAG/OnCE Port Buffer V_{DD}

In order to provide support for low voltage DSPs (5V-2.7V), an advanced low voltage CMOS buffer exists between the DSP56002 controller and the target JTAG/OnCE interface cable. This buffer has its V_{DD} pin connected to JG1, Pin 2. See Table 2-3 for CMOS buffer V_{DD} configuration.

Table 2-3. CMOS Buffer V_{DD} Configuration

V_{DD} Source	JG1
Supply V_{DD} from Host System (+5 V)	1–2
Supply V_{DD} from Target System (default)	2–3

Note: The universal command converter is factory-configured for the JTAG/OnCE buffers to be powered from the target system (JG1 2–3).

2.2.3 Command Converter Monitor Firmware Upgrades

The monitor code for the command converter, which is tailored for the target DSP family in use, is provided with the ADS software. The code is downloaded automatically into the

command converter during ADS system initialization and universal command converter reset. If a revision is issued for the monitor firmware, an environment variable must be defined to specify the filename of the revised monitor. The specified file will be loaded into the command converter instead of the standard monitor program. The variable which must be defined is CC56000, where "56000" is replaced with name of the DSP family in use, and the defined value is the fully-specified filename of the revised monitor software. For example,

- DOS, in AUTOEXEC.BAT:

```
SET CC56300=C:\ADS\REVISIONS\MONITOR.LOD
```

- UNIX, with C shell, in .login or .cshrc:

```
setenv cc56300 /ads/revisions/monitor.lod
```

- UNIX, with Bourne shell, in .profile:

```
cc56300=/ads/revisions/monitor.lod
export cc56300
```

specifies that, for the GUI56300, the standard DSP56300 family universal command converter monitor code is to be replaced by the code in the file ADS\REVISIONS\MONITOR.LOD**.**

To verify that the monitor file is loading correctly, start the ADS program and enter the following commands:

```
force s
display v
```

The monitor revision will be displayed. If the error 'Unable to reset Command Converter' is issued, make sure the correct path is specified in the definition of CC56x00.

2.3 Trouble Shooting the Command Converter

To ensure the command converter is connected correctly to the host card, there are several commands that are directed specifically to the command converter. The first is:

cforce r

This command will reset the ADS chain throughout the host card, up to the command converter. Another helpful command is:

cdisplay x:0#10

This command displays x memory locations 0 through 10 of the command converter. The values in memory are irrelevant, the fact that memory from the command converter can be read indicates that you are communicating correctly with the command converter. If these

two commands execute correctly, your ADS is working properly up through the JTAG port on the command converter. If you are still having problems, there may be something wrong with your 14-pin JTAG cable or target board.

Chapter 3
Functional Description

The application development system (ADS) user interacts with the target DSP through two subsystem components, the host computer interface and the command converter controller. The host computer interface consists of a program written in the C language that interacts with a host computer bus interface card. The command converter consists of a program written in DSP56002 assembly language which interacts with the host computer bus interface card and the target JTAG/OnCE port.

It should be noted that older versions of Motorola DSP products use the OnCE port protocol, while newer versions of Motorola DSP products use the IEEE JTAG 4-wire protocol to interact with their OnCE port. New versions of the command converter support both JTAG and OnCE protocols.

Commands entered from the host computer's keyboard are parsed and a series of low level command packets are sent to the command converter. The command converter translates these low level command packets into serial sequences that are transferred to the target DSP via its JTAG/OnCE port. The JTAG/OnCE port provides the necessary control to the target so programs may be loaded or saved, registers read or modified, and hardware breakpoints set or cleared.

The host computer interface is designed to communicate with as many as eight command converter cards. This requires a special software protocol to avoid data collisions between one target and another. The purpose of this section is to describe the subsystem components of the ADS to give a better understanding of the communication link between the user and the target DSP.

3.1 Host Computer Hardware

The host computer's hardware interface provides the communications link between the user and the command converter. The ADS user interface program uses a software handshake when communicating with the command converter. There are signals defined on the host computer bus interface card which are used for requesting and acknowledging information transfer. Since the handshake is software driven the transfer rate will be

dependent upon the host computer bus speed and its operating system. This section describes the host computer interface hardware and software components.

3.1.1 Host Computer Bus Interface Card

Figure 3-1 shows a block diagram of the host computer interface card for all computer platforms. The interface consists of three fixed addresses in the host computer I/O memory map. The host computer's interface card address zero is used as a control port for selecting, resetting, or interrupting one or more command converters. Address one reads and writes eight bit data bytes to one or more command converters. Address two acknowledges command converter service requests and selects group members for multiple command converter commands. All data is passed high-order byte first. For example, in a 32-bit transfer, bits 31–24 are transferred first, followed by bits 23–16, bits 15–8, and then bits 7–0.
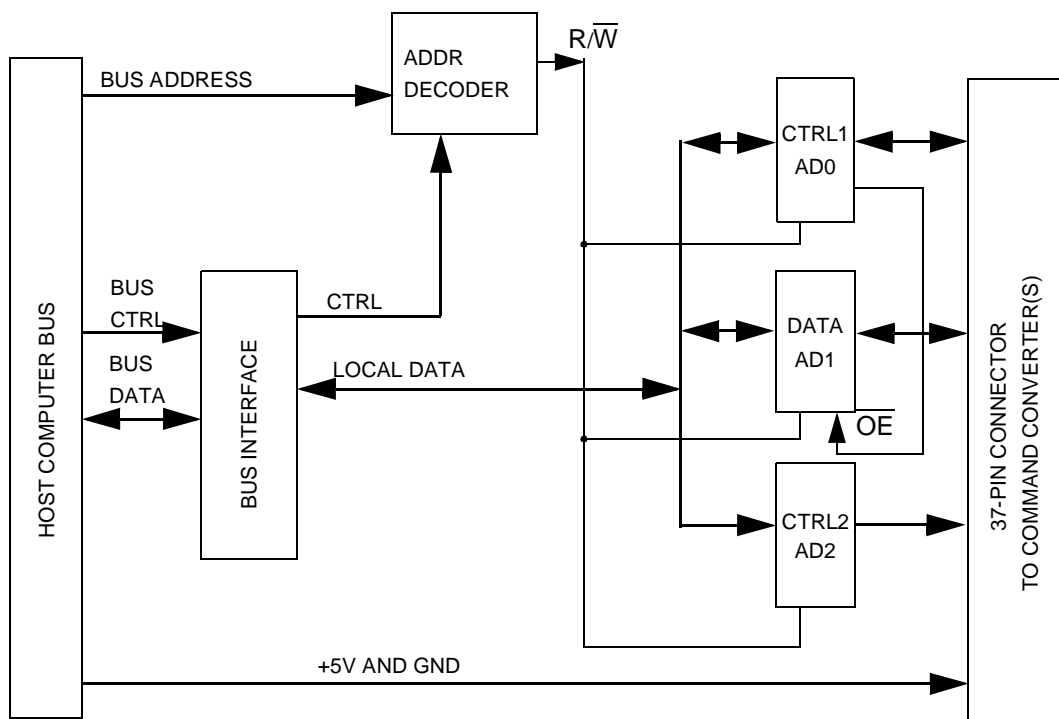
Figure 3-1.   Host Computer Bus Interface Card

The ADS user interface program allows as many as eight command converters to be addressed using one host computer interface card. Command converters may be addressed in groups or individually depending upon the command and command arguments entered by the user.

Host computer interface card address zero has eight output control lines. These output control lines are asserted using positive logic (V_{OH} = TRUE). Three address zero signals

(ADM_SEL0, ADM_SEL1, ADM_SEL2) select a command converter before sending a command. Further information on the method of command converter selection is discussed in subsequent sections.

Two handshake signals originate at the host computer and are used to pass data to and from a command converter. HOST_REQ initiates a data byte transfer to a command converter, while HOST_ACK acknowledges receipt of a data byte from a command converter.

Two control signals (ADM_BRK,ADM_RESET) allow the user to assert an interrupt or a reset exception on a single command converter or a group of command converters. The ADM_BRK signal is used to put the command converter back into Command Entry mode; the ADM_RESET signal is used to reset the command converter.

The command converter informs the host computer of target DSP entries to the Debug mode of operation by asserting the HOST_BRK signal. The ADS user interface program on the host computer periodically polls the HOST_BRK signal from the keyboard polling routine. If the HOST_BRK signal is asserted, the host computer will determine which command converter is requesting service by reading the ADM_INT signal. The INT_ACK signal is asserted by the host computer when a service request has been recognized. Further details on the functions of each signal will be given in a subsequent section. Figure 3-2 illustrates the 37-pin cable and the direction of the signal groups.

3.1.2 Host Computer Interface Cable

The host computer interface card interacts with the command converters via a 37-pin ribbon cable assembly. Each end of the ribbon cable has a 37-pin subminiature-D Insertion Displacement receptacle connector. The cable assembly is approximately 4 feet in length and is designed so that additional command converters may be easily attached to the existing cable by crimping on new connectors.

Normally the ADS is shipped with an application development module (ADM), and power for the command converter is supplied by the host computer interface card via the 37-pin cable. Power for the ADM card is provided by a wall power transformer. The ribbon cable is not designed to draw more than 2 amps current at 5 volts. Since each command converter draws approximately 250 milliamperes, it is safe to power all eight units via the cable, but the target systems must be powered by a different source to ensure correct operation.
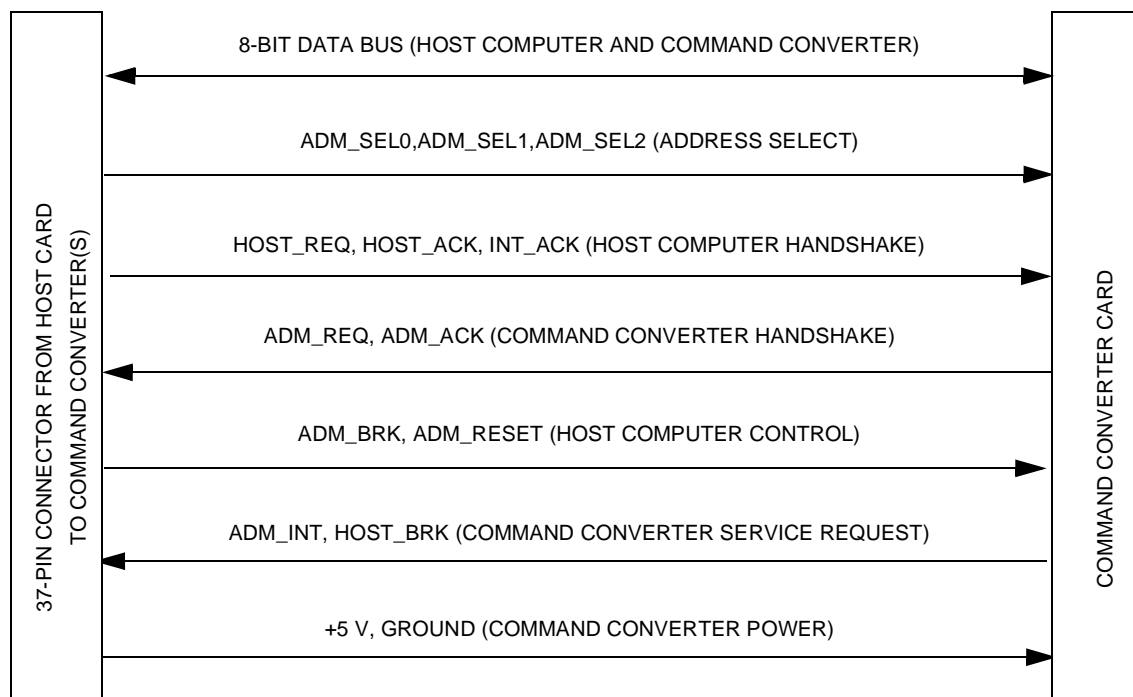
AA1946

Figure 3-2.   37-Pin Host Computer Interface Cable

3.1.3   Command Converter Card

The command converter is based on a DSP56002, which uses its on-chip resources to minimize and simplify the interface to the target JTAG/OnCE debug port. Communication with the host computer is via the DSP56002 Port B, while the serial interface to the target DSP is via the DSP56002's SSI port.

Each command converter has a unique address, ranging from 0 to 7. This allows the user to debug multiprocessor systems where as many as eight command converters are physically in the target system. JG2 of the command converter card defines the address selected for that card.
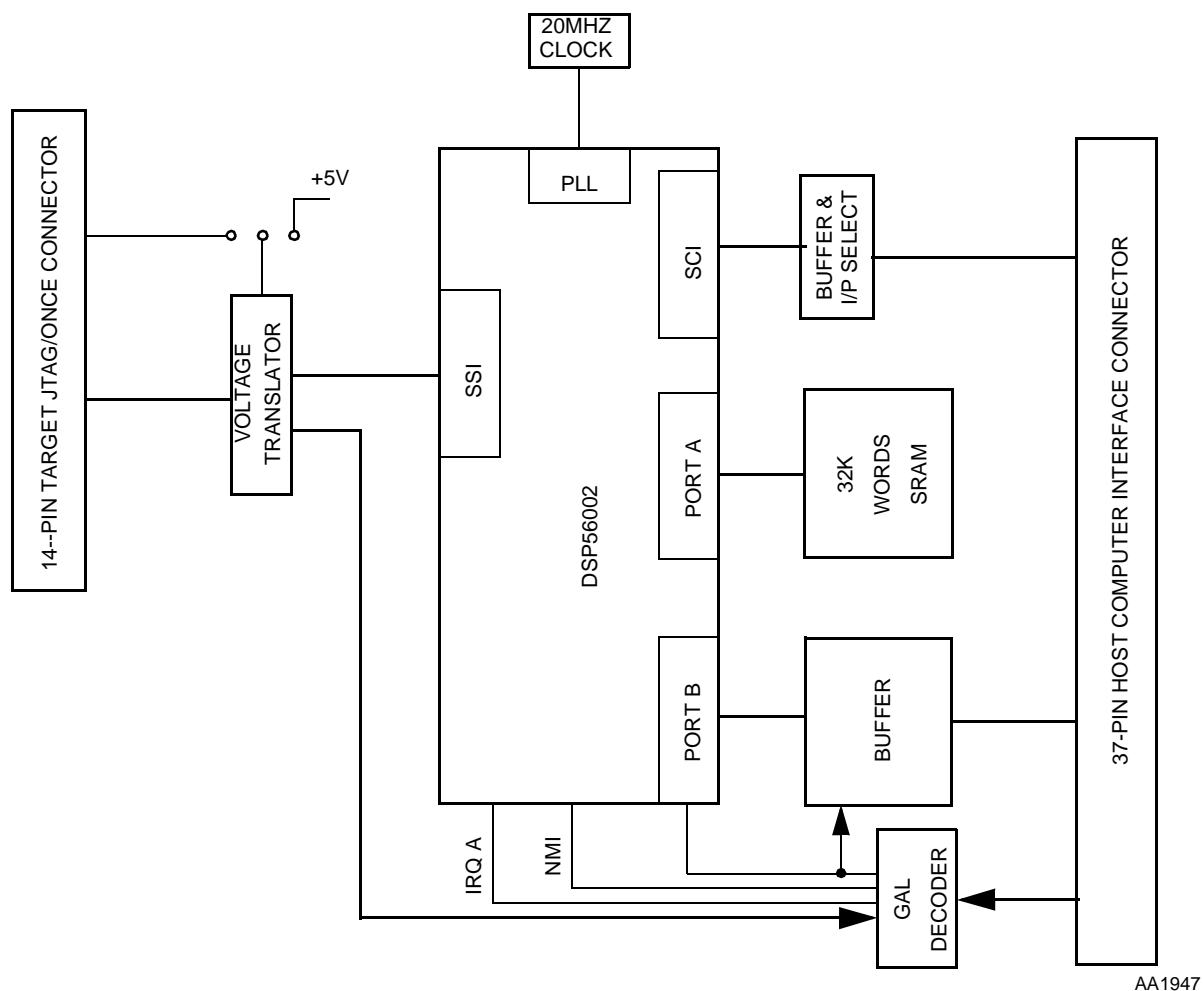
Figure 3-3.   Command Converter Block Diagram

3.1.4   Command Converter Handshake Signals

The DSP56002 on the command converter card is configured in such a way that bits 0–7 of its Port B are used for 8-bit data transfers, and bits 8–14 are used for data transfer control.

There are three output control bits in the middle order byte of the DSP56002 Port B data word. These bits are the ADM_INT, ADM_REQ, and ADM_ACK signals. ADM_REQ and ADM_ACK, act as handshake lines for reading and writing data. ADM_INT acts as a flag to indicate whether the ADM is requesting host computer service. These three control bits are part of the host parallel control bus. They are enabled when the host computer selects the ADM.

There are three input control bits in the middle-order byte of Port B data word that represent the HOST_ACK, HOST_REQ, and INT_ACK. These signals are sent from the host computer for reading and writing data. INT_ACK informs the monitor program that the host computer has received its service request and is ready to communicate.

$\overline{\text{HOST\_BRK}}$ is a wired-OR control line. $\overline{\text{HOST\_BRK}}$ is used by the command converter to inform the host computer whenever the target DSP has entered the Debug mode of operation for non-JTAG devices only. Since more than one command converter may be started for a user debug session, more than one may hold $\overline{\text{HOST\_BRK}}$ active low at one time. Once this signal is asserted it may only be deasserted by the host computer or by a command converter reset.

3.1.5 Command Converter Interface Connector

The target application board must have a 14-pin connector to interface to the command converter controller. This interface comprises nine signals and three ground connections on a 7-row × 2-column male pin header, which are spaced on 1/10 inch centers as illustrated in Figure 3-4 on page 3-7.

Since the target system will have a resident reset circuit, it is recommended to have an AND gate in series with the $\overline{\text{CC\_RESET}}$ signal. This will insure that the target DSP will be reset with a valid V_{OL} level from either the target reset circuit or from the command converter. The pull-down resistors are to insure that no false signals are propagated to the JTAG/OnCE circuit when the test data input/debug serial input (TDI/DSI) and test data clock/debug serial clock (TCK/DSCK) lines are active. The test data out/debug serial output (TDO/DSO) pullup is to insure that the Debug Acknowledge signal from the OnCE circuit is deasserted. The debug request ($\overline{\text{DR}}$) pullup is to insure that the command converter controls when the target DSP is placed into its Debug mode.
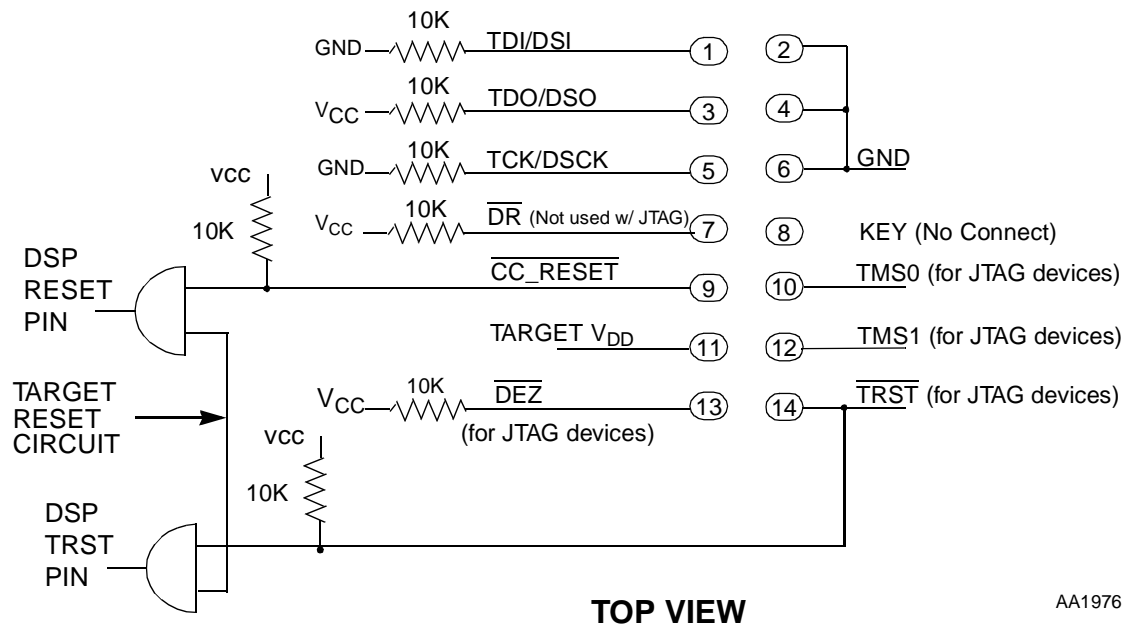
TOP VIEW   AA1976

Figure 3-4.   Target V$_{DD}$ System JTAG/OnCE Interface Connector

3.1.6 Multiple Target Connections

The basic JTAG connection comprises 5 pins, as illustrated in Figure 3-5.
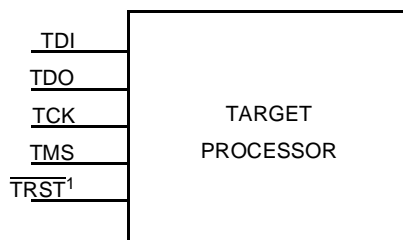
[1] IF PINNED OUT, REQUIRED ON DEVICE

AA1975

Figure 3-5.   JTAG Connections

Multiple target devices may be connected in series, allowing a single command converter JTAG/OnCE connector to control multiple devices, as in Figure 3-6. Data flows from the JTAG host, into each JTAG implementation through TDI, out through TDO and into TDI in the next chip, eventually returning to the JTAG host.
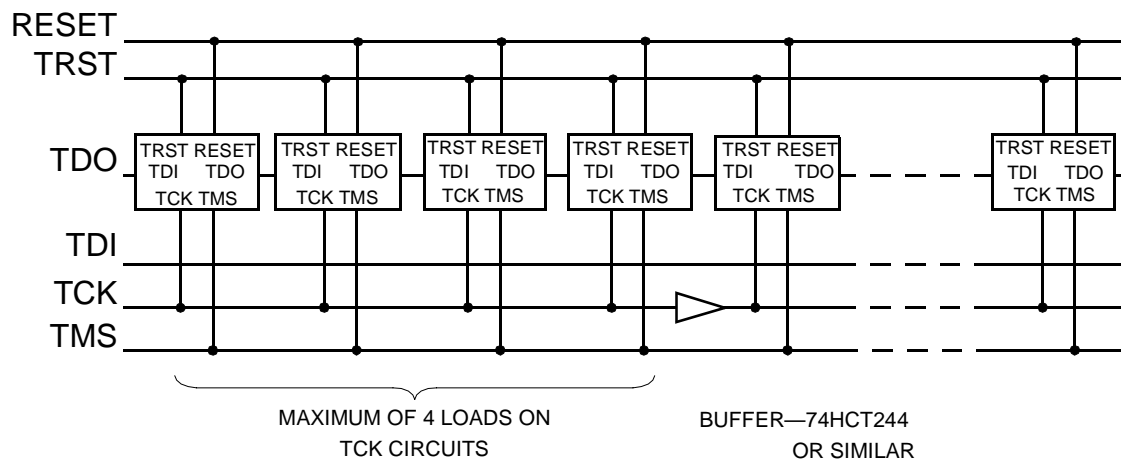
AA1950

Figure 3-6.   Multiple JTAG Target Connections

3.1.7 TCK Drive and Timing Considerations

The signals from the command converter are TDO, TCK and TMS, and $\overline{\text{TRST}}$. Signal TCK requires fast rise and fall times dictated by the TCK pin timing specification, and consequently attention must be given to the drive capabilities of the circuits driving this signals. There is no problem with TDO, as each TDO output is connected to only one TDI input. TMS need only be valid at the rising edge of TCK, similarly there is no problem with $\overline{\text{TRST}}$ as the reset signal is not subject to the timing constraints of TCK.

There is a potential problem with driving the TCK circuit with a large number of target devices. The problem is related to the rise and fall times of TCK, caused by excessive capacitance, which can cause communication problems with a single circuit connecting multiple TCK input pins.

Acceptable transition times may be achieved for TCK by driving no more than four JTAG inputs from each buffered output. This may be achieved with two configurations.

Figure 3-6 shows one method. Here (in effect) one signalling connects each of the TCK inputs. A buffer is placed in the circuit after each fourth input, at most, to restore the signal quality for subsequent inputs. The propagation delay of the buffer is not significant.

Figure 3-7 shows another possible configuration which also enables signal quality to meet the requirements. In this configuration the signal is split and buffered into a number of parallel TCKn signals. Each of these signals may drive up to 4 TCK inputs.
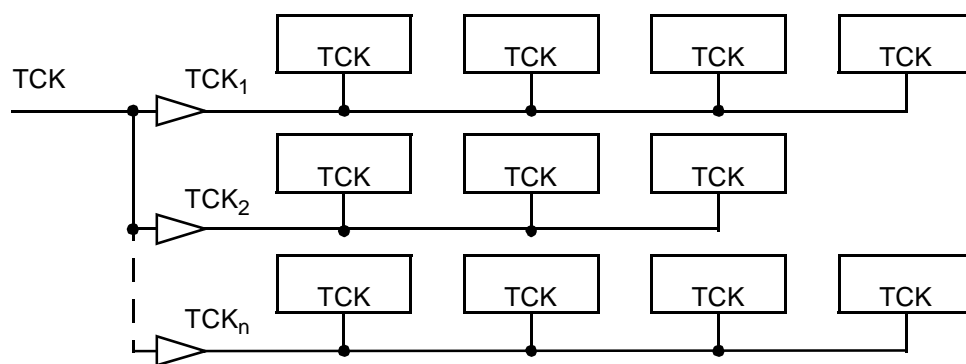
Figure 3-7.   Fan Out of TCK at Source

Either configuration above is equally valid. The choice will depend on practical considerations related to each project, or a combination could be used.

JTAG signal TMS may also need some consideration. Although TMS is not subject to the strict requirements as TCK, it is still important that TMS has settled to a valid level at the rising edge of TCK.

3.1.8 Resetting Target DSP Devices.

The RESET signal and TRST signals from the command converter are typically connected to all target devices on a JTAG chain. $\overline{\text{RESET}}$ and $\overline{\text{TRST}}$ are asserted by the ADS command FORCE R. All devices on the JTAG chain handling the specified command converter device are reset. Execution control is established immediately after deassertion of TRST before any instructions are executed. The sequence of events is illustrated in Figure 3-8. Because all targets on the JTAG chain are connected to the same $\overline{\text{RESET}}$ signal, all devices enter reset. The JTAG controller is still active after deassertion of TRST during reset, and while $\overline{\text{RESET}}$ is held low, the JTAG instruction DEBUG_REQ is clocked in. When $\overline{\text{RESET}}$ is deasserted, the device is immediately in Debug mode, with no instructions executed since releasing $\overline{\text{RESET}}$.
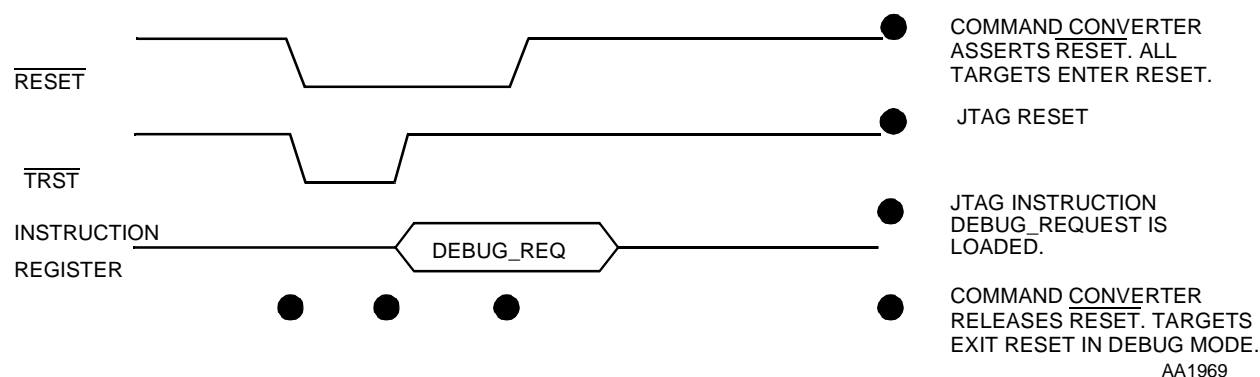
Figure 3-8.   Reset JTAG Device with $\overline{\text{RESET}}$ Signal

Chapter 4
Host Computer Card and Command Converter Support Information

This chapter provides the host computer connector signal descriptions, part lists and schematics for hardware that is required to run with the ADS software. This list includes the host interface cards, host interface cable, and the command converter card.

4.1 Host Interface Card Bus Signal Description

Each host interface card is designed for a unique host computer bus architecture. This section describes the card edge connector signals used by each host computer's expansion bus. This information is for reference only.

Table 4-1. PC Interface Card J2 (ISA-16 Bus) Connector

Pin #	Mnemonic	Signal Name and Description
A1	I/O CH CK	No Connect
A2–A9	D7–D0	PC Bus data bits 7 to 0.
A10	I/O CH RDY	No Connect
A11	AEN	PC BUS Address Enable output
A12–A21	A19–A10	No Connect
A22–A31	A9–A0	PC Bus address bits 9 to 0.
B1	GND	PC ground
B2	RESET	PC reset signal,(positive true).
B3	+5v	PC +5 V
B4-B8		No Connect
B9		PC +12 V
B10	GND	PC ground
B11–B12	MEMW/MEMR	No Connect
B13	IOW	I/O write command,(negative true).
B14	IOR	I/O read command,(negative true).
B15–B20		No Connect
B21	IRQ7	PC Interrupt request 7,(Printer), NOT USED.
B22–B23		No Connect
B24	IRQ4	PC Interrupt request 4,(COM1), NOT USED

Table 4-1. PC Interface Card J2 (ISA-16 Bus) Connector (Continued)

Pin #	Mnemonic	Signal Name and Description
B25	IRQ3	PC Interrupt request 3,(COM2),
B26–B31		No Connect

Table 4-2. Sun 4 SPARC (SBus) Connector

Pin #	Description	Pin #	Description	Pin #	Description
1	GND	33	PA(06)	65	D(18)
2	$\overline{BR}$	34	PA(08)	66	D(20)
3	$\overline{SEL}$	35	PA(10)	67	D(22)
4	$\overline{INTREQ1}$	36	$\overline{ACK0}$	68	GND
5	D(00)	37	PA(12)	69	D(24)
6	D(02)	38	PA(14)	70	D(26)
7	D(04)	39	PA(16)	71	D(28)
8	$\overline{INTREQ2}$	40	$\overline{ACK1}$	72	+5V
9	D(06)	41	PA(18)	73	D(30)
10	D(08)	42	PA(20)	74	SIZ(1)
11	D(10)	43	PA(22)	75	RD
12	INTREQ(3)	44	$\overline{ACK2}$	76	GND
13	D(12)	45	PA(24)	77	PA(01
14	D(14)	46	PA(26)	78	PA(03)
15	D(16)	47	DTAPAR	79	PA(05)
16	$\overline{INTREQ4}$	48	-12V	80	+5V
17	D(19)	49	CLK	81	PA(07)
18	D(21)	50	$\overline{BG}$	82	PA(09)
19	D(23)	51	$\overline{AS}$	83	PA(11)
20	$\overline{INTREQ5}$	52	GND	84	GND
21	D(25)	53	D(01)	85	PA(13)
22	D(27)	54	D(03)	86	PA(15)
23	D(29)	55	D(05)	87	PA(17)
24	$\overline{INTREQ6}$	56	+5V	88	+5V
25	D(31)	57	D(07)	89	PA(19)
26	SIZ(0)	58	D(09)	90	PA(21)
27	SIZ(2)	59	D(11)	91	PA(23)
28	$\overline{INTREQ7}$	60	GND	92	GND
29	PA(00)	61	D(13)	93	PA(25)
30	PA(02)	62	D(15)	94	PA(27)
31	PA(04)	63	D(17)	95	$\overline{RESET}$
32	$\overline{LERR}$	64	+5V	96	+12V

4.2 Host Computer Interface Cable

The 37-pin cable which connects to the host computer is called the host computer interface cable. This cable provides the signals and power to the command converters.

Table 4-3.   Host Computer Interface Cable

Pin #	Mnemonic	Signal Name and Description
1	INT_ACK	Host ack of ADM service request
2	ADM_GROUP	CC group control flag from Host
3	HOST_ACK	Host ack of ADM data transfer request
4	ADM_ALL	Host signal which selects all ADMs
5	ADM_RESET	Host signal which asserts CC(s) reset
6-8	ADM_SEL2,1,0	CC address select signals 2-0 for one of 8 CCs
9	HOST_REQ	Host signal which requests CC data
10	ADM_REQ	CC signal which requests Host data transfer
11	ADM_ACK	CC ack of Host data transfer request
12	ADM_INT	CC service request status signal to Host
13	$\overline{\text{HOST\_BRK}}$	CC service request signal to Host, (low true)
14	ADM_BRK	Host signal to interrupt CC(s)
15	BRACE_SEL	Brace56 Emulator select signal
16-19	PD1,3,5,7	HOST/CC data bus bits1, 3, 5, 7
20-25	GND	HOST/CC ground lines
26	NC	No Connect
27-29	+5v	+5 volts from the HOST
30	HOST_ENABLE	HOST signal which enables CC address logic
31-33	GND	HOST/CC ground lines
34-37	PD0,2,4,6	HOST/CC data bus bits 0, 2, 4, 6

4.3 JTAG/OnCE Interface Cable

The command converter 14-pin connector is connected to the target system through the JTAG/OnCE interface cable. These signals provide the control signals to as many as 24 target DSPs or other JTAG devices.

Table 4-4.   JTAG/OnCE Connector J2

Pin #	Signal	Signal Description
1	TDI/DSI	Target JTAG/OnCE Serial Input
2	GND	Ground
3	TDO/DSO	Target JTAG/OnCE Serial Output
4	GND	Ground
5	TCK/DSCK	Target JTAG/OnCE Serial Clock
6	GND	Ground

Table 4-4.   JTAG/OnCE Connector J2 (Continued)

Pin #	Signal	Signal Description
7	$\overline{DR}$	Target OnCE Debug Request Input
8	No Connect	Used as Key
9	$\overline{CC\_RESET}$	Target DSP Reset Input
10	TMS0	Target JTAG Test Mode Select 0 input
11	Vdd	Target Vdd—Supplies OnCE Buffer (HC367)
12	TMS1	Optional Target Test Mode Select 1 (not required)
13	$\overline{DEZ}$	Target JTAG/OnCE Debug Event (input/output)
14	$\overline{TRST}$	Target JTAG Reset Input
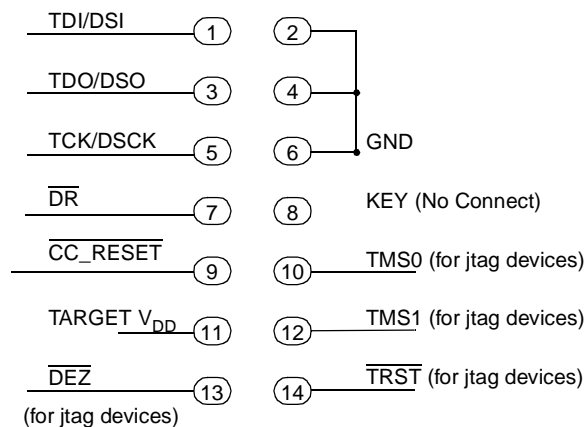
Figure 4-1.   Command Converter Interface

Note: This is a plug connector that has all odd numbers on the left side and all even numbers on the right side when viewing from top. Pin 1 is on upper left side. Spacing between pins is 1/10th of an inch. Refer to command converter J2 connector as an example.

4.4 Host Computer Card Bills of Materials

This section contains the bill of materials for each of the host computer interface printed circuit board assemblies in the ADS.

Table 4-5.   ADS PC-Workstation Interface Electrical Parts List Rev 2.01

Qty	Description	Ref. Designator	Vendor Part #
		Integrated Circuits	
1	MC74LS04D	U1	Motorola
2	MC74F521DW	U2,U3	Motorola

Table 4-5.   ADS PC-Workstation Interface Electrical Parts List Rev 2.01 (Continued)

Qty	Description	Ref. Designator	Vendor Part #
1	MC74F138D	U4	Motorola
2	MC74F32D	U5,U6	Motorola
1	MC74LS00D	U7	Motorola
1	MC74F245DW	U8	Motorola
2	SN74ALS373DW	U9,U11	Texas Instrument
2	SN74ALS575DW	U10,U13	Texas Instrument
1	SN74ALS374DW	U12	Texas Instrument
1	MC74F125D	U14	Motorola
Resistors			
1	100 KΩ	R1	Bourns CR1206-1003-FVCA
1	10 KΩ	R2	Bourns CR1206-1002-FVCA
Resistor Networks			
1	10 KΩ—8 resistor pack-common pullup	RN1	Bourns 4610X-101-103
1	22 Ω—8 series resistors	RN2	Brady 4816-P-001-220
1	22 Ω—10 series resistors	RN3	Brady 4820-P-001-220
Capacitors			
15	0.1 μF	C1–C15	Murata GRM42-6COG104K050BL
2	100 μF	C16,17	Sprague 501D107M6R3LL
Note: Resistors are 5% 1/4 w carbon (unless otherwise specified).			

Table 4-6.   ADS PC-Workstation Interface Hardware Parts List Rev 2.01

Qty	Location	Description	Vendor Part #
Jumpers			
1	JG1	5 row $\times$ 2 berg stick	R.N. NSH-10DB-S2-TG30
1	JG2	8 row $\times$ 2 berg stick	R.N. NSH-16DB-S2-TG30
Connectors			
1	J2	AMP 37-pin SUB-D Connector	AMP 745097-1
Miscellaneous			
1		PC Bracket	Olsen 9007001
2		4-40 3/8 Screws	
2		4-40 3/8 Nuts	
1		AMP Female Screwlocks	AMP 205817-3
2		Molex jumpers	Molex 15-29-1024

Table 4-7.   37-Conductor Cable Assembly List Rev 2.0

Qty	Description	Vendor Part #
2	AMP Mating Connector	AMP# 747319-1
1	37-Conductor Ribbon Cable 4 ft.	T&B/Ansley
	28AWG,stranded, .050 inch pitch	#171-37

Table 4-8.   Sun-4 SBus Parts List Rev 01

Qty	Description	Ref. Designator	Vendor
2	74ACT138	U10,12	Motorola
4	74ACT244	U4,7,8,9	Motorola
1	74ACT245	U11	Motorola
1	74ACT02	U6	Motorola
1	74ACT08	U5	Motorola
1	74ACT32	U2	Motorola
1	74ACT04	U1	Motorola
1	74F374	U17	Motorola
1	74F273	U18	Motorola
2	74ACT273	U13,16	Motorola
1	74F373	U19	Motorola
2	74ACT373	U14,20	Motorola
1	PALCE22V10H-15PC/4	U3	AMD
1	WS57C291B-35T	U15	WSI
2	R pack 8×2 22 Ω	RN1,2	Bourns 4116R-001-RC
1	100 k Ω	R1	Newark 10F305
20	0.01 µf Ceramic	C22	Kemet C322C104M5R5CA
1	10 µf Electrolythic Axial	C22	Sprague 501D106M063LL
1	100 µf Electrolythic Axial	C21	Sprague 501D107M010LM
2	24 Pin IC socket	U3,15	R.N. ICE-243-S-TG30
1	SBUS Male connector	J1	Fujitsu FCN-234P096-GO
1	37-pin D connector	J2	Amphenol 617-C037P-AJ221

4.5 Command Converter Bill of Materials

Table 4-9.   ADS Command Converter Electrical Parts List Rev 7.0

Qty	Description	Ref. Designator	Vendor Part #
		Integrated Circuits	
1	DSP56002PV66	U1	Motorola
1	DS1233-5	U2	Dallas Semiconductor
1	SG-531P-20.000MC	U3	Epson
1	MC74F245DW	U4	Motorola
2	MC74HC244ADW	U5, 8	Motorola
1	MC74F373DW	U6	Motorola
1	CD74AC244M	U7	Harris

Table 4-9. ADS Command Converter Electrical Parts List Rev 7.0 (Continued)

Qty	Description	Ref. Designator	Vendor Part #
3	CY7C199-15VC	U9,10,11	Cypress
1	PALCE20V8Q15PC	U12	AMD
Resistors			
1	3 KΩ	R9	Bourns CR12060302JVCA
24	10 KΩ	R13,17,21,23-30,38-41,44,45, 47-50, 54-56	Bourns CR12061002JVCA
2	1.8 KΩ	R16,37	Bourns CR12060182JVCA
2	1 KΩ	R43,46	Bourns CR12060102JVCA
15	220 Ω	R1-8,10-12,14,15,18-20	Bourns CR12060220JVCA
4	330 Ω	R6,33,51,52	Bourns CR12060330JVCA
2	100 Ω	R42,53	Bourns CR12060100JVCA
1	510 Ω	R22	Bourns CR12060510JVCA
5	51 Ω	R31,32,34-36	Bourns CR12060051JVCA
Capacitors			
12	0.01 μF	C1,11-17,20,23,27,29	Kemet C1206C103K5RAC
16	0.1 μF	C3-10,18,19,21,22,24,26,28, 30	Kemet C1206C104K5RAC
1	390 pF	C2	Kemet C1206C391J5GAC
Transistors			
2	2N3904	Q1, 2	Motorola MMBT3904LT1
Light Emitting Diode			
1	Green SMT	LED1	Hewlett Packard HSMG-C650

Table 4-10. ADS Command Converter Hardware Parts List Rev 7.0

Qty	Description	Ref. Designator	Vendor Part #
Jumpers			
1	1 × 3 Bergstik	JG1	SAMTEC TSW-103-07-S-S
1	2 × 3 Bergstik	JG2	SAMTEC TSW-103-07-S-D
Connectors			
1	37-Pin Connector	P1	Amphenol 617C037PAJ221
1	2 × 5 Bergstik	J1	SAMTEC TSW-105-07-S-D
1	2 × 7 Bergstik	J2	SAMTEC TSW-107-07-S-D
Sockets			
1	8-PIN DIP Socket	U3	Mill-Max 110-93-308-41-001
1	24-PIN/300 DIP Socket	U12	Mill-Max 110-93-324-41-001
Switches			
1	SPST Mom PushButton	SW 1	Panasonic EVQ-QS205K

Table 4-10. ADS Command Converter Hardware Parts List Rev 7.0 (Continued)

Qty	Description	Ref. Designator	Vendor Part #
Miscellaneous			
4	Rubber Feet	N/A	Amatom #5186
4	3/ 4" Nylon Standoffs	N/A	HH Smith
4	4-40 x 1/4" Nylon Screws	N/A	Waldon

Table 4-11. JTAG/OnCE 14-Pin Cable Assembly

Qty	Description	Vendor Part #
2	IDC Receptacle Connector	Dupont #66432-014
1	12" Flat Ribbon 14-Pin Cable	Dupont #76825-014
2	Polarization Plug	Dupont #65762-001

4.6 ISA-16 Bus Host Interface Card Schematics

Figure 4-2. ISA-16 Host Interface Card Address Decoder (1 of 4)
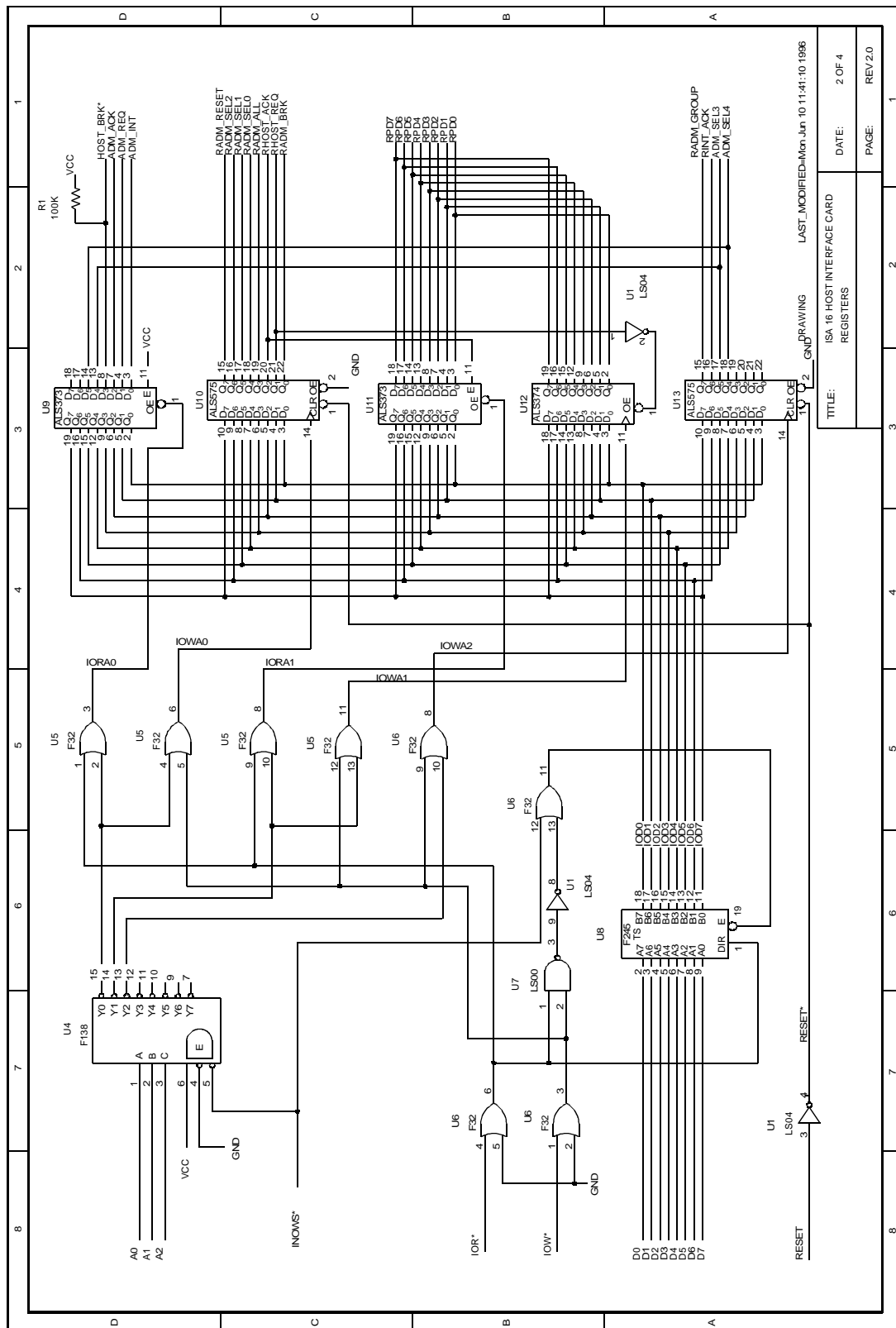
Figure 4-3. ISA-16 Host Interface Card Registers (2 of 4)

Figure 4-4.   ISA-16 Host Interface Card Connectors (3 of 4)
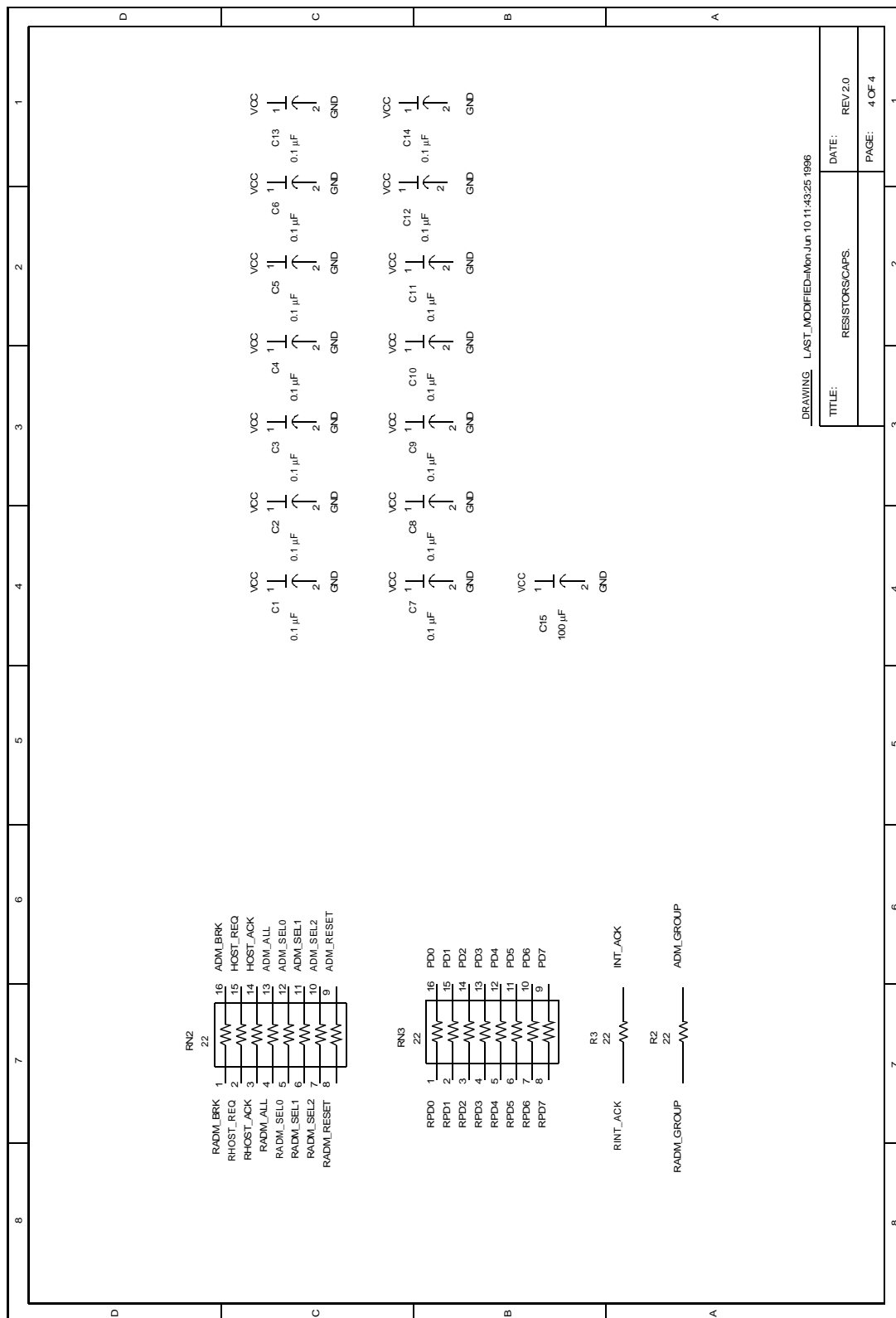
Figure 4-5. ISA-16 Host Interface Card Resistors and Capacitors (4 of 4)
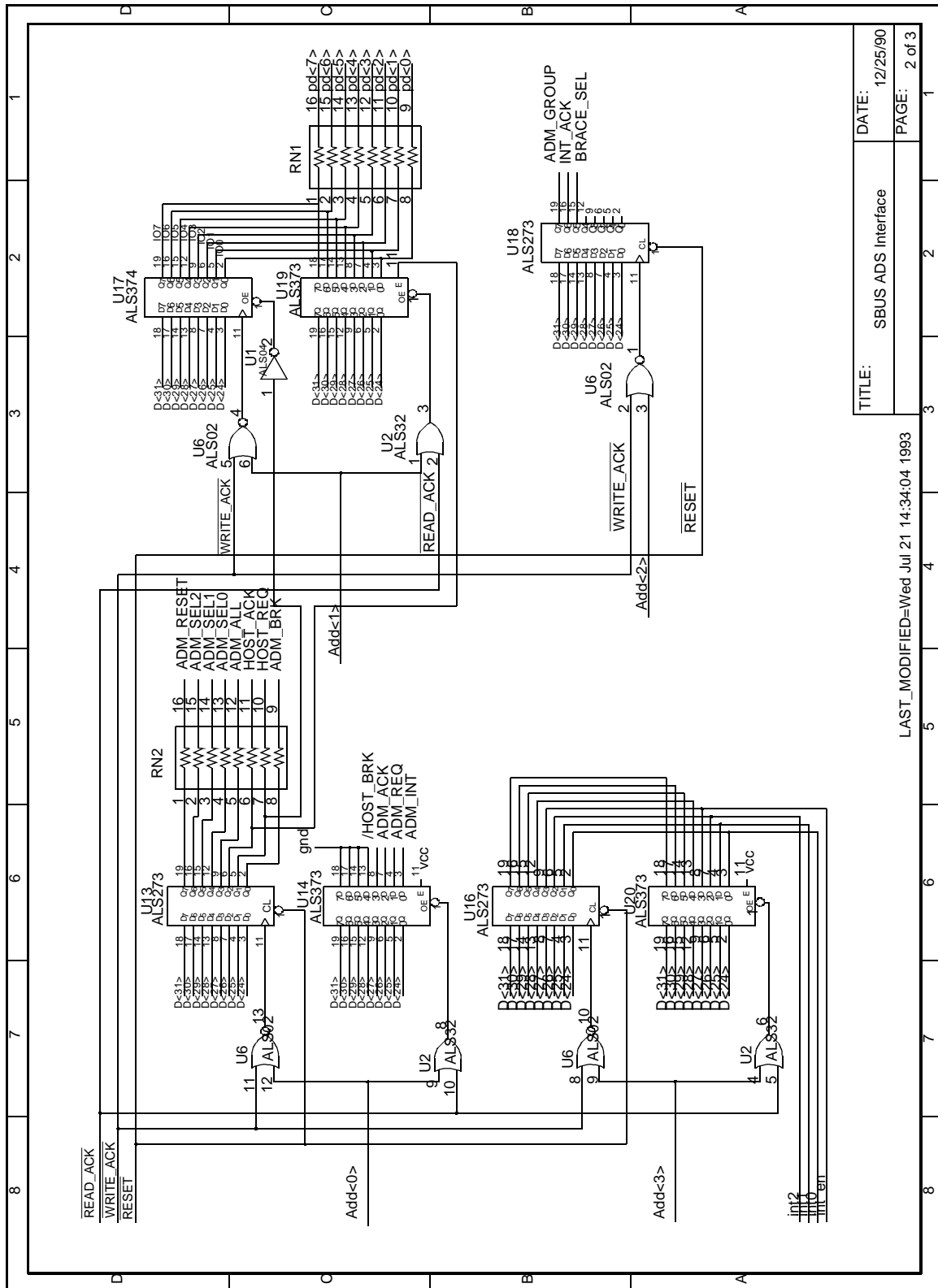
4.7 SBus Host Interface Card Schematics

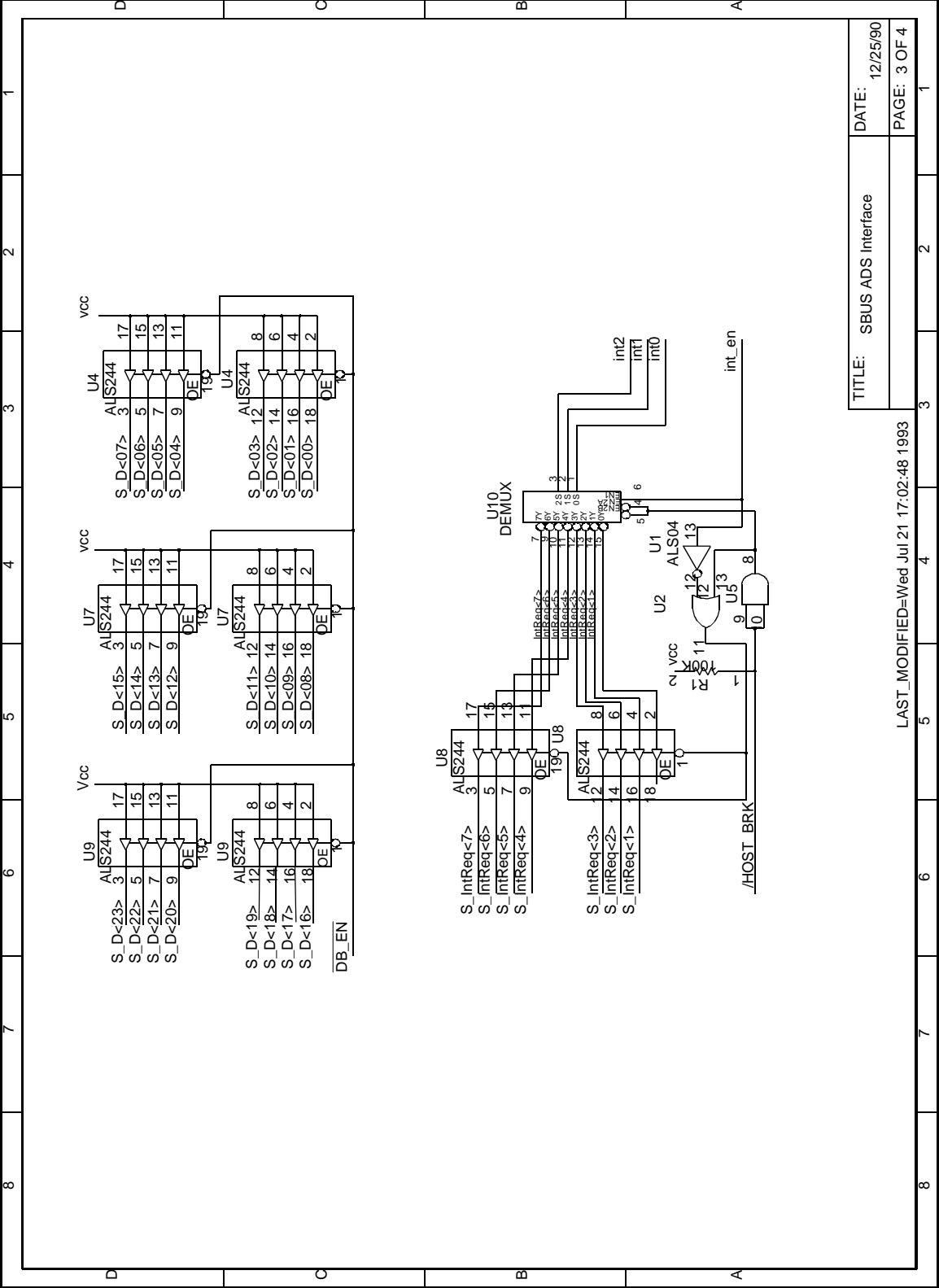**Figure 4-6. SBUS Address Decoders (1 of 4)**

Figure 4-7.   SBUS ADS Interface (2 of 4)

Figure 4-8.   SBUS ADS Interface (3 of 4)
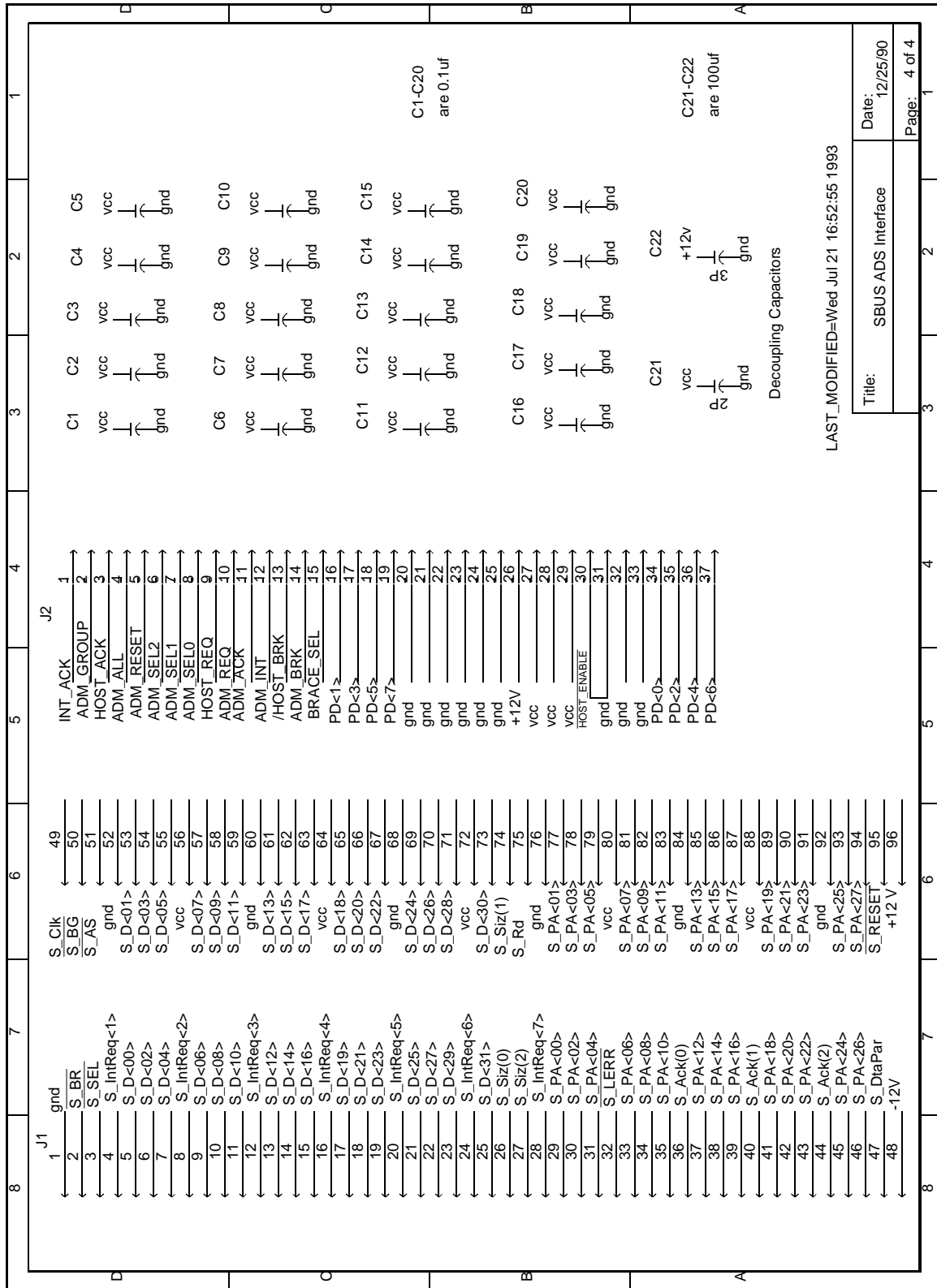
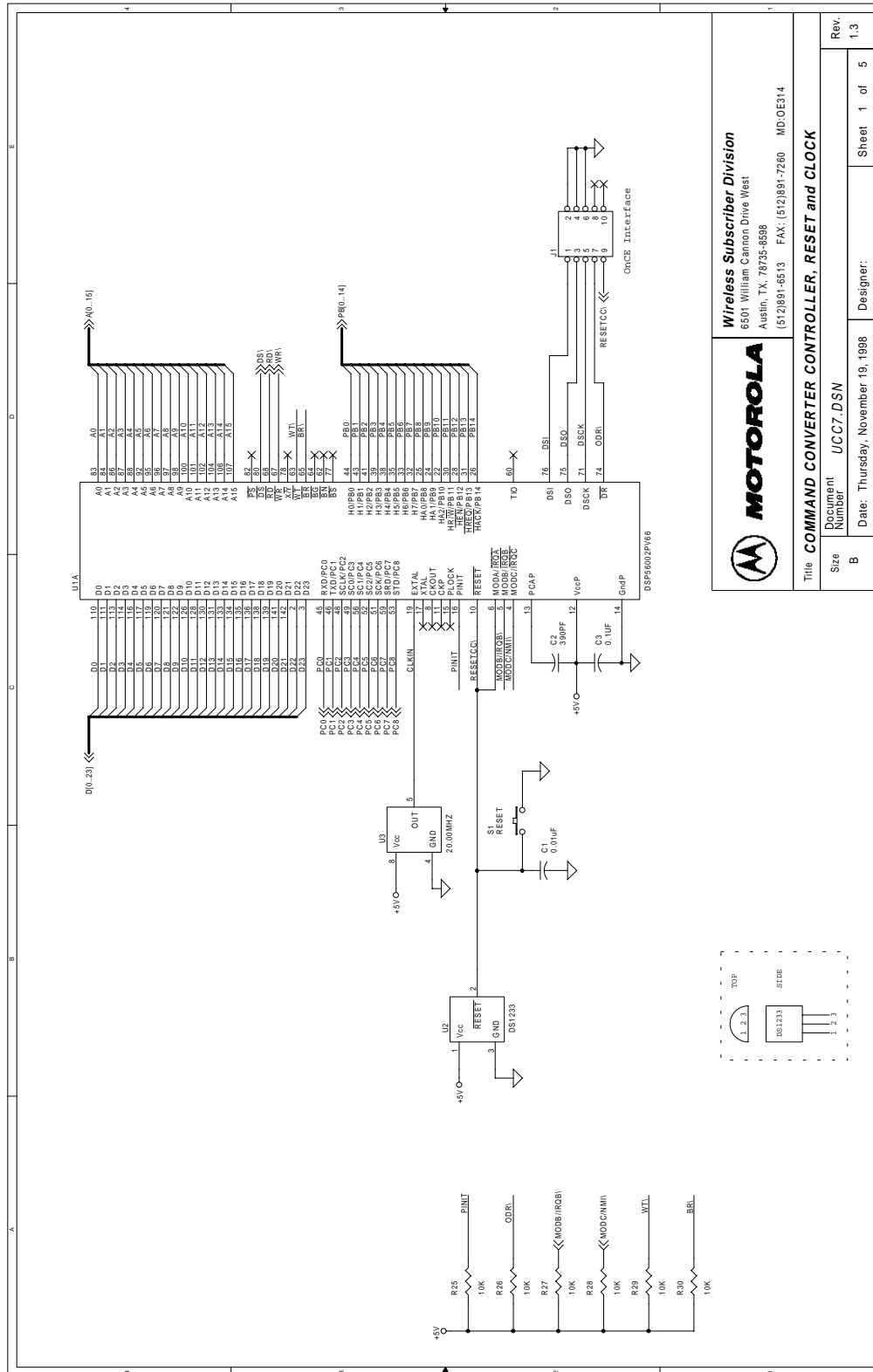**Figure 4-9.   SBUS ADS Interface (4 of 4)**

4.8 Command Converter Card Schematics

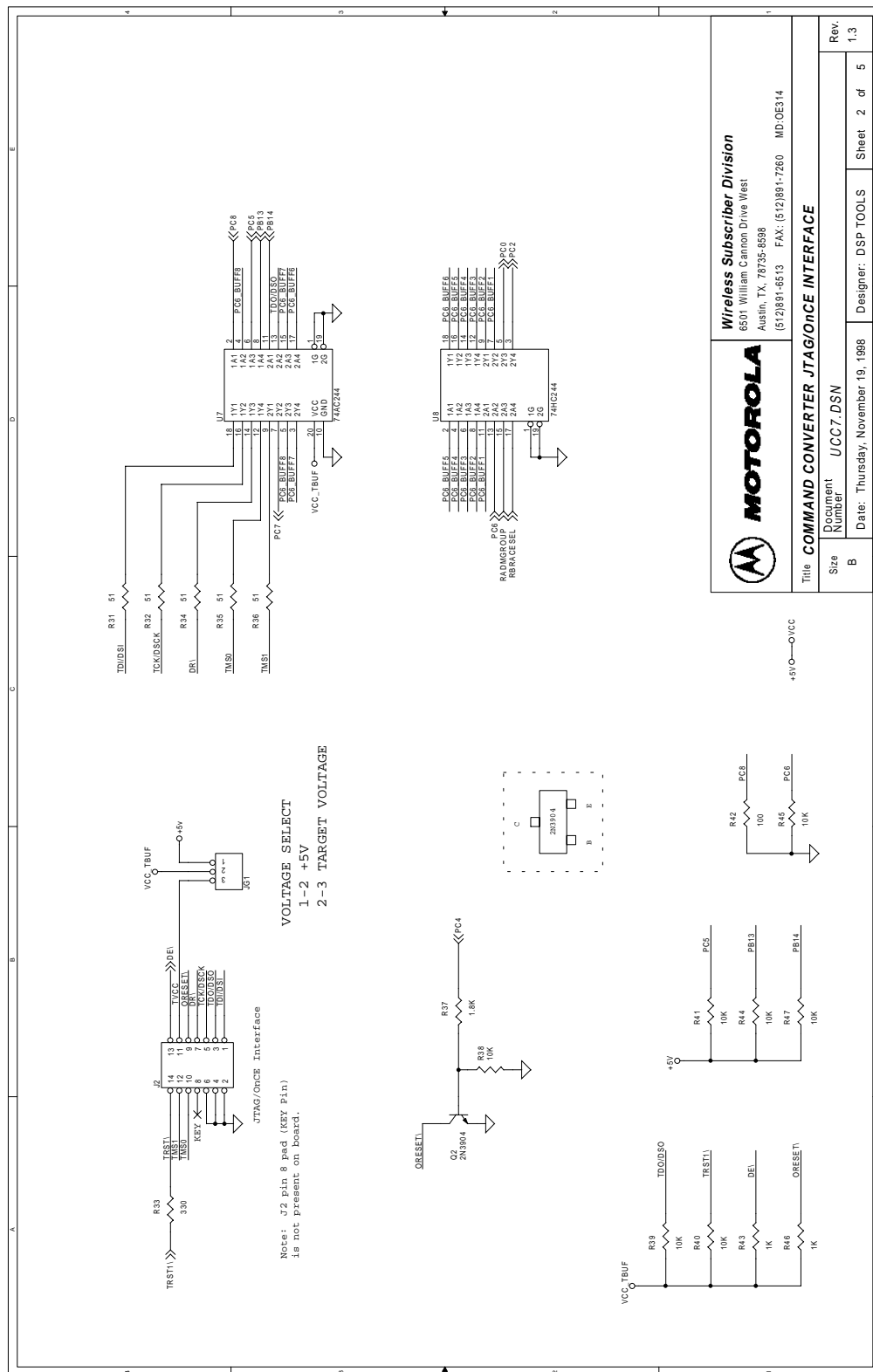**Figure 4-10. Command Converter Controller, RESET and CLOCK (1 of 5)**

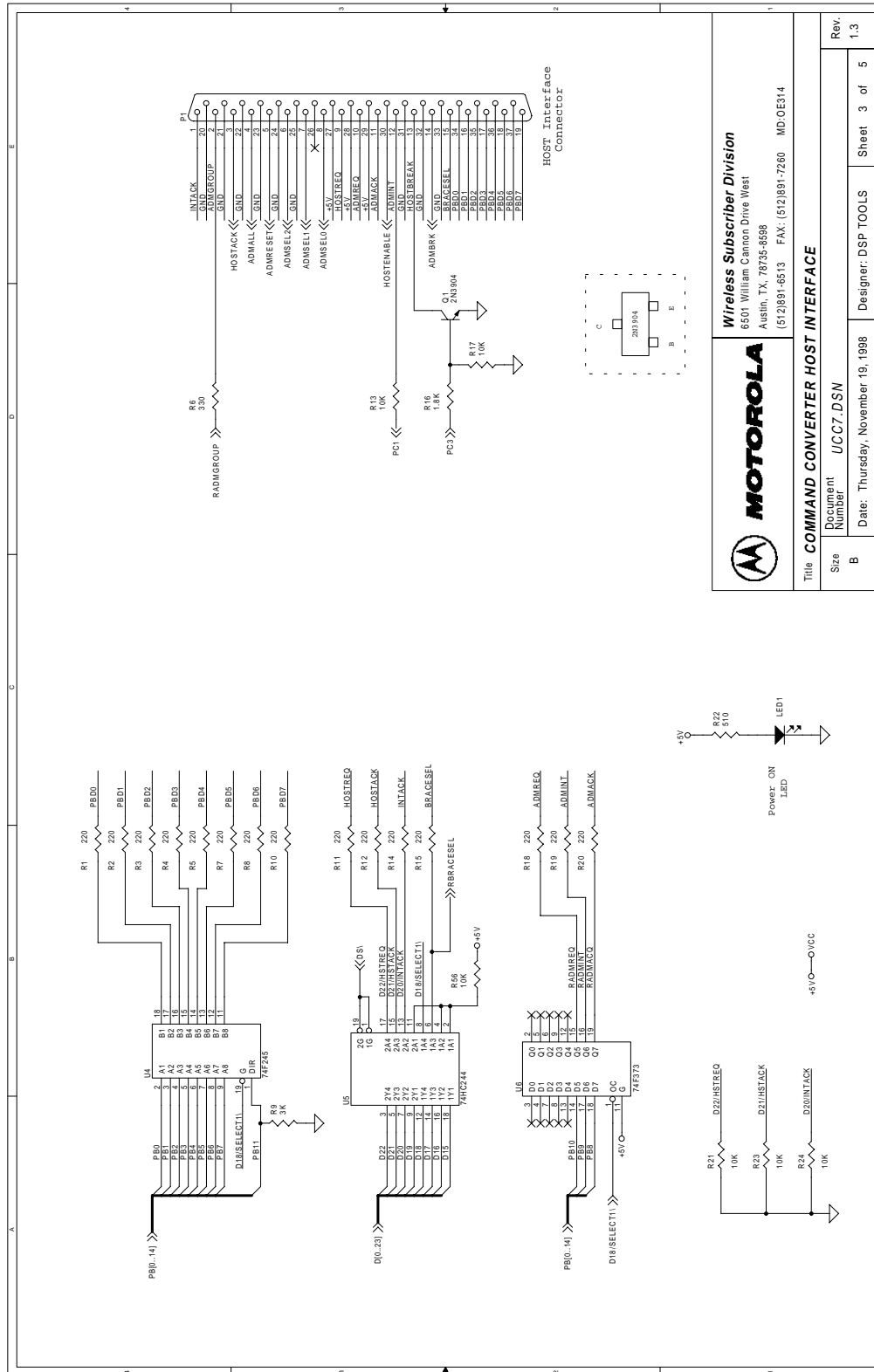**Figure 4-11.   Command Converter JTAG/OnCE Interface (2 of 5)**

Figure 4-12.   Command Converter Host Interface (3 of 5)

Figure 4-13. Command Converter SRAM and Select Logic (4 of 5)

Figure 4-14.   Command Converter Decoupling (5 of 5)

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